



Report from the Scientist Advisory Council

Louise Suter, Lauren Hsu, Phil Adamson
on behalf of the Scientist Advisory Council
PAC meeting, Jan 18, 2019

What I will talk about

- Introduction
- Overview of SAC and the previous retreats
- Working group summaries from the second retreat
- Fermilab inputs to current/ongoing planning processes
- Plans for 2019 retreat
- Summary and conclusions

- Meet ~weekly
- Representation from directorate joins when possible
- Discusses a range of topics
 - Future planning
 - Lab policy changes
 - Scientist issues

The Scientist Advisory Council is a group of approximately 15 members of the Fermilab scientific staff. The composition of the group is diverse in areas of expertise and experience. Terms are for a two-year period, with half of the group rotating out each year. At the beginning of September each year, the laboratory director solicits nominations via the “all-scientists” distribution list. The demographics being sought will be announced (i.e. number from each organizational unit). Self-nominations are accepted. Following the open nomination period, new council members are selected by the current council in consultation with the director. New terms begin October 1.

The council will meet regularly (approximately weekly) with the director. The charge to the council is to engage in open discussion on topics of interest for both short- and long-term plans for the laboratory’s research program. The council will also discuss issues related to careers and professional development of the Fermilab scientific staff.

Members of the council are encouraged to share the discussion topics within their respective organizations to gather feedback and input from the broader scientific staff that the council can then share with the director. On occasion, the outcome of discussions may lead to the council initiating a sub-committee study of a theme or convening an all-scientist retreat to engage broader discussion of the topic.

Last updated August 29, 2014

SAC members 2018-2019

New members serving from
Oct 1, 2018 to Sept 30, 2020:

Karie Badgley (TD / Mu2e)
Daniel Elvira (SCD / CMS)
Zoltan Gesce (PPD / CMS)
Brendan Kiburg (PPD / Muon)
Petra Merkel (PPD / CMS)
Diktys Stratakis (AD / Muon)
Louise Suter (ND / NuMI)
Matt Toups (ND / MicroBooNE)

Continuing through Sept 30, 2019:

Phil Adamson (AD / Accel, co-chair)
Eliana Gianfelice-Wendt (AD / Theory)
Nick Gnedin (PPD / Astro Theory)
Roni Harnik (PPD / Theory)
Lauren Hsu (PPD / SuperCDMS)
Martina Martinello (TD / SRF)
Gabe Perdue (SCD / Sim)
Anna Pla-Dalmau (PPD / Eng Supp)
Charles Thangaraj (Dir / IARC)

[Link to the list of current and past members on the public SAC Fermipoint site](#)

Introduction: The Fermilab All-Scientist Retreats

By request of Directorate, Scientist Advisory Council organized two scientist retreats to discuss the future of the laboratory's science program

- First retreat: May 4, 2017
- Second retreat: April 26, 2018
- Planning for third retreat, late spring or summer 2019

Each was preceded by weeks of preparatory discussions and work within a set of pre-defined working groups

- Scientists invited to participate in working groups of interest

Working groups for each retreat were charged with specific set of goals

Overall goal is to ensure Fermilab is ready to contribute to community planning

Organization for the retreats

| | Working group | Conveners 2017 retreat | Conveners 2018 retreat |
|------------|-------------------------|---|--|
| Physics | Cosmic science | Bradford Bensen, Andrew Sonnenschein | Bradford Bensen, Lauren Hsu, Albert Stebbins |
| | Energy frontier science | John Campbell, Anadi Canepa, Dmitri Denisov, Bogdan Dobrescu, Sergo Jindariani, Vladimir Shiltsev | Anadi Canepa, Dmitri Denisov, Paddy Fox, Sergei Nagaitsev |
| | Neutrino science | Mike Kirby, Alexander Himmel, Louise Suter | Zarko Pavlovic, Louise Suter, Joseph Zennamo |
| | Precision science | Doug Glenzinski, Brendan Kiburg, Juliana Whitmore | Doug Glenzinski, Mark Lancaster, Chris Polly |
| Technology | Accelerator science | Sam Posen, Thomas Strauss, Alexander Valishev, Bob Zwaska | Jonathan Jarvis, Martina Martinello, Nikolay Solyak, Charles Thangaraj, Alexander Valishev |
| | Computational science | Oliver Gutsche, Gabriel Perdue | Adam Lyon, Jim Kowalkowski |
| | Detectors for science | Juan Estrada, Petra Merkel, Vadim Rasu | Juan Estrada, Angela Fava, Petra Merkel, Vadim Rusu |
| | Applied science | Jin Chang, Charles Thangaraj | NA |
| | Quantum Science | NA | James Amundson, Roni Harnik |

Working group leaders for 2019 retreat are not finalized, expect overlap with previous years for continuity

2017 retreat

Goals

- Gather view of scientific staff on long-term plans for Fermilab research program
- Collect input on the Fermilab 10-year plan (pre-2026) and longer-range outlook (post-2026)
- Facilitate communication between different groups at the lab related to long-range goals

Emphasis was on thinking, not making decisions, setting priorities or limits

Desired output

- A report from the retreat, coordinated by SAC
- A starting draft of
 - a schedule of events / work needed to give input to next P5 process
 - a strategy for how to engage with larger US / International HEP community
 - a list of possible long-term lab goals
 - an estimate of what new work is needed
- A staff better organized, connected and informed about technology developments and science/mission overlaps in other communities

2018 retreat

In planning / organizing the second retreat

- Specifically asked to address the lack of substance in the post-2026 outlook
- Some changes to address cross-communication issues
 - Asked physics groups to address relevant applied sciences
 - Started 2 months earlier to reduce conflicts in meeting times
- Added a group around new efforts on quantum science

Goals given a narrower focus

- Giving charge to specifically answer certain questions
 - What are the interests of the Fermilab scientists for the decade following 2026?
 - How do we give our input to the US community planning and the European Strategy Group?
 - What is the post-retreat plan for working with US, European and other partners to give our input?
- Considerations
 - Build on the previous retreat
 - Speak to needed facility construction/upgrades, R&D, new physics knowledge
 - Consider activities at Fermilab, and at other places Fermilab should be involved in
 - Consider how we should approach coordinating with area communities

2018 retreat and continued activities

- Most working groups met twice or more prior to the retreat
 - Attendance and participation in most was robust
 - Retreat attended by >160 scientists
- WG conveners presented summaries of working group discussions, conclusions, followed by an open discussion session
- Conveners asked to write a brief summary for a report with major outcomes, planned or suggested follow-up work
- Some but not all groups have continued to meet regularly
- Most groups have had continued activity in some form, including providing input to the DPF white papers and producing Fermilab specific white papers for input to the ES



Working group summaries

Cosmic science

- FNAL Cosmic Program consists of major efforts in Dark Matter, Dark Energy and CMB; theory supports and guides these efforts
- Plans for next few years are well defined:
 - G2 dark matter searches, Dark Energy/CMB stage-3 experiments
- Retreat discussions focused on long-term possibilities and a broad program
 - Dark matter, dark energy, inflation/neutrinos, and the R&D that seeds this science
- Detailed internal discussions of opportunities and options for exploring each area
- Priorities that emerged for 2026+ were leadership in the following areas:
 - CMB S4, a next-generation axion search, low mass dark matter searches, and a future large-scale survey telescope
- Retreat discussion have been superseded by “Cosmic Steering” planning for Fermilab astrophysics department (committee formed over the summer).
 - Cosmic steering presented a focused, and prioritized plan to DOE last month (Dec)
 - Considered three funding ”scenarios”
 - See Josh Frieman’s talk from yesterday for more details

Working group summaries

Energy frontier science working group

- Involved in a broad program of planning activities at the energy frontier
 - Technologies, accelerators, physics, detectors, community planning
 - Engaged community beyond the Fermilab staff
- Coordinated by a team with wide expertise, A. Canepa, D. Denisov, P. Fox, A. Grassellino, S. Nagaitsev, S. Posen
- Holding monthly meetings since May 2018
 - Two presentations per meeting covering various future colliders options
 - pp, e^+e^- , muon collider
 - Accelerators and accelerators technology
 - Physics and detectors
 - Active participation from Fermilab and non-Fermilab scientists and engineers
- Participated in the development of “white papers” proposals for the European Strategy
 - DPF white paper preparations
 - FCC and ILC white papers preparations
 - Fermilab’s “yellow paper” on accelerator complex development plans
- Actively engaged in the development of Snowmass program
 - Serving on DPF meetings planning committee
 - Plan to attend Snowmass townhall meeting during April APS and engaged in developing agenda of that meeting

Retreat Working group summaries

Neutrino science working group

- Examined where experimental and theoretical knowledge expected to be in 2026
- Identified interest among staff in wide-range of non-overlapping topics
 - Discussed neutrino beams beyond LBNF; options for post LBNF/DUNE, precision tau neutrino appearance experiments; LBNF beam for taus, neutrino factories, and neutrinoless double beta decay, relic neutrinos
- Created a vision for continued work and discussion post retreat
- Neutrino working group did not continue to meet regularly after the retreat.
- But the working group leaders and other interested parties produced input to DPF white paper and the European Strategy in the form of a ‘yellow paper’ describing the status of the Fermilab Neutrino Facilities

Status of Fermilab’s Neutrino Facilities

A. Fava, J. L. Raaf, P. Shanahan, L. Suter, Z. Pavlovic, J. Zennamo, R. Zwaska

Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510, USA

December 18, 2018

Working group summaries

Precision science working group

- Has been a ongoing planning effort since the first retreat
 - Worked to narrow the focus to a small number of experiments with: impact; good alignment with Fermilab strengths; a strong user community; and are feasible
 - Aiming to formulate a program for 2025+
- Engaged with the precision community from the outset
 - Working with collaborating partners on current & proposed experiments / concepts
 - **Jointly submitted white papers to ESG** describing Mu2e-II
 - **A Joint Submission with the spokespersons of 3 other muon-CLFV Experiments**, “Searches for Charged Lepton Flavor Violation using Intense Muon Beams at Future Facilities”
 - Worked with DPF authors/editors to ensure Mu2e-II was included in the “Explore the Unknown” and “Detector R&D” sections of the DPF submission
- Held workshops
 - Mu2e-II, <https://indico.fnal.gov/event/17536/overview>, Summary: <https://mu2e-docdb.fnal.gov/cgi-bin/ShowDocument?docid=21498>
 - Goal - develop R&D plan for each sub-system and identify highest priority items well attended (>75 participants), plenary & parallel sessions over 2 days
 - Muon EDM: discuss options for utilize g-2 storage ring to make a dedicated muon EDM experiment
 - Estimate that with silicon trackers in all 24 stations could improve current limit by x100

Working group summaries

Accelerator science and technology working group

- Strategic goals
 - Leadership in beam physics and accelerator technology
 - Provide accelerator technologies for future accelerators
- Discussed the plan to achieve these goals
 - Maintain robust R&D program around IOTA/FAST facilities, broad collaborations, alignment with international strategy and context
 - Enable full exploitation of existing complex via cost effective upgrades, physics driven path to 2.4 MW
 - Push R&D in various related areas, e.g., high-power targetry & RF / beam cooling
 - Drive superconducting RF R&D with Nb, new materials, new collaborations
 - Advance superconducting magnet R&D looking in new directions, cost/performance optimization
- Working group produced input to DPF white paper and the european strategy in the form of a 'yellow paper' describing the status of the Fermilab Accelerator Complex.

Fermilab Accelerator Complex: Status and Improvement Plans

*Mary Convery, Michael Lindgren, Sergei Nagaitsev and Vladimir Shiltsev
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Retreat Working group summaries

Computational science working group

- Already strongly engaged in community planning
 - Major contributor to community white paper to determine R&D roadmap for HL-LHC and DUNE
 - Involved with HEP-CCE, HSF (HEP Software Foundation) to identify, pursue cross-cutting R&D opportunities
- Discussed on-going push to exploit current generation of computing architectures, new technologies and techniques
 - High performance computing, hybrid computing, machine learning, frameworks,...
 - Concrete plans for 2021-22 goals, a vision for 2025-26; noted that projecting beyond that is speculative for computing technologies.
- The community white papers from HSF are nearly all available on arXiv
- Fermilab is a main contributor to almost every topic
- Working group meetings to refine and plan R&D efforts are ongoing, with an important HSF meeting coming up at JLAB in March.
 - Continued progress on SciDac projects awarded by DOE OHEP/ASCR
 - Executed reorganization to form new group to emphasize Machine Intelligence in Reconstruction

Working group summaries

Detectors for science working group

- Build upon synergies with other working groups.
 - Identified forward-looking R&D topics and broader areas where workstreams can be combined, resources optimized
 - Contribute to physics-driven white papers in cooperation with science groups, tailoring proposals for technological developments to the scientific scope
- Recommendations from working group
 - Increase accessibility to resources and facilities for detector R&D
 - Reduce barriers between divisions
 - Monthly inter-division meetings to facilitate communication, sharing of goals, explorations of feasibility
- Suggestions for further engaging broader community
 - Launch collaborations on specific R&D projects, sharing of infrastructure
 - Award grants specific for staff exchange, collaborative networks
 - Participate in DPF CPAD workshops to foster exchange of research
- Group did not continue to regularly meet post retreat
- Through the Detector Advisory Group the key players continue to discuss strategies and ideas for future detector R&D, for which many of the key players are present and all key instrumentation areas at the lab are represented
- Key players also contributed to the DPF white paper “Detector R&D” section and the Fermilab neutrino yellow paper

Working group summaries

Quantum science working group

- A new area, but already with a broad range of R&D directions.
 - HEP technology for quantum computing: e.g., high-Q SC cavities, cold instrumentation
 - Quantum technology for HEP experiments, Quantum networking, Quantum computing for Fermilab science
- An active group with connections across HEP and industry
- Have pursued a strategy of submitting proposals to funding calls
 - Highly successful so far, with several more in the pipeline
 - Fermilab is a recognized leader in this area
 - Most of the proposals discussed at the retreat have since been funded. That's of order ten million dollars in research funding.
- The lab wide effort is substantial
- Quantum Information Science is an emerging new direction for Fermilab and is developing rapidly. Plans for the near and medium term future are being made within Fermilab's Quantum Science Program.
- A new administrative structure has been put in place, the Quantum science program (headed by Panagiotis)
- Discussion underway on the plans for the national center in QIS.

Scientist Retreat 2019

- Initial planning has started for the 2019 retreat.
 - SAC chairs have met with the directorate, and the SAC and directorate have discussed within the SAC meeting.
 - We want to build off the work of the last retreats.
 - Learn from the ES, taking white papers produced from the ES effort as input
- Retreat will be aimed at continuing the discussion of “What do we want to do after the current round of projects is completed?”. This should provide input to the Snowmass process.
 - “Fermilab should be prepared for P5” - Nigel Lockyer
- We have multiple planning processes in play (Snowmass, European Strategy, Fermilab Strategic Plan, and our own). How can we better support and integrate with those efforts ?
 - Continue to be engaged with DPF
 - How to preserve this as an exercise for Fermilab staff, yet remain engaged with larger community? Fermilab is not trying to “jump start or hijack the Snowmass process”

Scientist Retreat 2019

- SAC is in the process of forming working groups and putting together a charge.
 - Aiming for draft charge by the end of the month.
 - Some aspects of the charge will be specific to the working groups
- Ideally we would like to have a focused plan with critical mass of scientists working on individual projects. How do we achieve this?
 - Produce prioritized list (in broad high/medium/low categories)
 - What are most important things to the field of HEP (and sub-fields)?
 - Of these items, which efforts should Fermilab contribute too?
 - Which items do Fermilab scientists actually want to work on?
 - We may create a poll to produce quantitative information
- Output of retreat will be written report which can be provided to PAC and input to community planning
- Feedback from the last two retreats is that there was not enough group time before the retreat, so plan to push retreat to later in the year
 - SAC chairs in process of determining possible dates

Summary and conclusions

- The two retreats succeeded in spurring discussion and exploring ideas related to long-range plans across the Fermilab science program
- Many groups created for this retreat continued to meet or evolved into additional planning activities
- Multiple inputs to the DPF white paper and to ESG via these activities
- The plans for the 2019 Retreat are being discussed, we welcome any input or comments from the PAC